United States Department of Agriculture	**Forest Service**	**Moose Creek Ranger District Nez Perce Clearwater National Forest**

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Subject: Clear Creek Integrated Restoration Project DSEIS Aquatics Report
To: District Ranger

This report provides a variety of new information not displayed in the 2015 Clear Creek Integrated Restoration Project FEIS. New baseline aquatic habitat and species information was collected on anadromous fish streams in 2015 and 2016 and summarized here. This additional data resulted in the determination that South Fork and Hoodoo Creek prescription watersheds do not meet their Forest Plan water quality objectives and therefore require an upward trend analysis. Changes to the effects analyses including FISHSED model updates and upward trend for South Fork and Hoodoo are included. Only updated information is presented below.

Additional information is disclosed about geology in the project area and NEZSED modelled cumulative sediment generated by roads. For the SEIS, NEZSED road sediment data was partitioned by prescription watersheds to see which roads were modeled to produce the most sediment. Those results were used in conjunction with additional WEPP Batch Road analysis. Different than NEZSED, the WEPP Data models specific road segments with multiple attributes to predict which road segments are more likely to produce sediment that could be routed to stream systems. Results of the two models were compared and then investigated in the field in August 2018 to assess model predictions on those segments that were expected to produce the most sediment (Roads 286, 1114, 1855, 1106, and 650). Combined modeled and field review data were used to confirm sediment producing road segments already have treatments planned to ensure that sediment resulting from road use would be minimized. Primarily updated information is presented below.

Scope of the Analysis

The project area is about 43,700 acres and encompasses the upper two-thirds of the Clear Creek drainage and all of its tributaries. Clear Creek flows into the Middle Fork Clearwater River. This same area is considered the analysis area and was selected because it includes all Forest Service–managed lands—and all the streams therein—that could be affected by project activities.

Regulatory Framework

There are no changes to the regulatory framework from the 2015 FEIS. Please refer to the 2015 FEIS pgs. 3-1 through 3-2 for a discussion of the framework.

Analysis Methodology

Stream and Habitat Surveys

The 2015 FEIS (pgs. 3-2 through 3-3) discusses in detail the methodology used to assess existing conditions in the project area. Additional stream channel, habitat and fish density information was collected on 27 miles of Forest Service and 4 miles of private streams by Stillwater Sciences in 2015. These surveys updated the baseline for the mainstem of Clear Creek, and portions of the West, South, and Middle Forks of Clear Creek as well as Lost Mule, Pine Knob and Brown Springs Creek. They also established two monitoring sites on the West Fork of Clear Creek and the lower mainstem of Clear Creek at the Forest boundary. The two sites were revisited in 2016 and a report discussing the changes between years was prepared (Stillwater Sciences, 2016). Both reports are available in the project file.

Additional road surveys were conducted along two main haul routes (Road 286 and 650) in 2016 in order to locate cross drain culverts in relation to existing stream crossings. Most of the culverts were replaced or added in 2015. Additional drainage work continues under the 2013 Road 286 and Road 650 Reconstruction projects.

FISHSED Modeling

The Forest Plan requires the use of the NEZSED and FISHSED models when assessing potential effects to sediment in streams at the Forest Plan prescription watershed level. The 2015 FEIS (p. 3-3) provides an overview and the limitations associated with these models. As disclosed in the model documentation (Stowell 1983), the model outputs are reasonable estimates and not absolute numbers of high statistical precision. Results obtained are to be used in combination with sound biological judgment. The models, therefore, are only useful for comparing alternatives and are not designed to predict actual changes in cobble embeddedness (Conroy and Thompson 2011). Updated FISHSED calculations for the resurveyed streams are summarized in the effects section.

Resource Indictors

The resource indicators and the reasons for their use are discussed in detail in the FEIS (pgs. 3-3 through 3-4). They are:

- RHCA road density
- Number of undersized culverts replaced and cross drains added
- FISHSED results for modeled changes in cobble embeddedness

Existing Conditions

Aquatic Habitats

Like many watersheds in central Idaho, the Clear Creek watershed has steep valleys with portions of the watershed underlain by the Idaho batholith. Other portions of the middle and upper watershed consist of older and harder belt metasediments that do not erode as easily as granitics. Finally, the lower watershed is overlain by geologically newer basalt flows, the hardest of the 3 rock types (Geology Map, project file).

Stream substrates through the drainage vary from sand in the low gradient channels to boulders, rubble and gravel in the remaining channels. Many low gradient channels have relatively high percentages of fines which may be a combination of batholith geologies (35% of the watershed) and past management activities, mostly roads. Granitic geologies tend to have naturally higher amounts of sand and roads contribute fines through surface erosion. The fine substrates typically settle out in lower gradient stream channels and can embed cobbles and gravels and reduce habitat quality for fish. The majority of fish spawning habitat occurs in low gradient stream reaches. The highest quality and quantity of salmon and steelhead spawning substrate was observed in the South Fork Clear Creek above the barrier that was removed in 1990. Lower quality habitat was noted below the barrier and in the mainstem of Clear Creek. Overhead cover and wood was noted as limited in the South Fork, lower Middle Fork, and mainstems of Clear Creek. We hypothesize wood and sediment conditions in the lower elevation portions of these prescription watersheds are mostly naturally occurring levels and are an outcome of past wildfires and geology. Similar conditions have been noted in stream reaches that have not been influenced by management as well as in stream reaches that have been (Stillwater, 2015).

Stream surveys conducted on private lands in lower Clear Creek indicated high levels of sediment and higher-than-preferred stream temperatures (NPT 1987). Sediment levels and temperatures were lower on

NFS lands (NPT 1984). Recent surveys (2015) showed lower cobble embeddedness levels on the surveyed private lands compared to NFS lands; however the data between the two surveys is not comparable as the same survey method protocols were not used. Temperatures remain higher on private lands due to the natural warming that occurs from the headwaters toward the mouth of a drainage as well as less canopy cover over the mainstem stream (Stillwater Sciences, 2015). Shallow water depths and lack of pool habitat were noted as issues affecting fish production in the middle and upper reaches of Clear Creek. Surveys conducted in 1993 and 2015 also noted the same sediment, wood, and pool limitations. The low number of pools is directly related to low wood levels. This is because wood is the primary creator of pool habitats in these stream types. Low wood levels are mostly a result of a large wildfire that burned the area in 1931. Stream bank stability was noted as good to excellent throughout the drainage due to the presence of dense streamside vegetation and large substrate (cobble, rubble, boulders) which armor the banks against the erosive power of the streams. Bank stability remained in good to excellent condition based on 2010-2012 field observations and 2015 habitat surveys.

Stream Temperatures

General information on stream temperature including what processes affect it and the conditions on private lands related to it can be found in the 2015 FEIS, pgs. 3-5 through 3-8.

Water temperature is an important factor in the successful reproduction of fish and other aquatic organisms. Some species prefer very cold temperatures and others more moderate temperatures. Streamside riparian vegetation provides the greatest protection against changes in water temperature primarily through shading (Sugden et al 2012; Sridhar et al, 2004; Lee, et al 2004; Ott et al 2005; FEMAT, 1993). Water temperature criteria designed to maintain cooler temperatures is provided through both the state of Idaho as well as federal regulations.

Optimal stream temperatures for juvenile chinook salmon and steelhead trout rearing is 14–19 °C (US EPA 2003). Lethal temperatures for juveniles occur if they constantly exceed 21–23 °C for 1 week or longer. Optimal stream temperatures for juvenile bull trout rearing is 9-14°C (IDEQ, 2003; Rieman et al, 2007) which is considerably colder than for other salmonids.

Stream temperatures were monitored throughout Clear Creek and its tributaries between 1991 and 2016. The year and number of times monitored varied by stream (Table 1). The warmest years on record varied by stream as a result of local and annual weather patterns.

Streams on Forest Service managed lands stayed below or at 19 °C maximum temperatures for all sites in all measured years with the exception of Clear Creek at the Forest boundary in 2015 (Table 1). All streams measured had maximum stream temperatures that were within the optimal range for salmon and steelhead juvenile rearing as noted by EPA. No streams exceeded lethal temperatures for juveniles. Streams rarely met optimal requirements for juvenile bull trout rearing during the summer months. IDEQ (2014) reported no water quality limited streams within the drainage.

Table 1: Maximum Stream Temperatures Measured Throughout the Clear Creek Drainage on Forest Service Managed Lands

Stream	Maximum Temperature Range (°C)	Number of Years Monitored Between 1991 and 2016	Warmest Year Recorded
Clear Creek at FS Boundary	15–20	1991, 1993, 2006, 2015, 2016	2015
Clear Creek at Pine Knob	15–19	1995, 2011, 2015	2015
Hoodoo Creek	15–17	1991, 1992, 1995-1998-2001, 2011	1998
WF Clear Creek	15–18	1991, 2011, 2012, 2015, 2016	2015

SF Clear Creek at mouth	19	1991	1991
SF Clear Creek above Kay	14–19	1991-1994, 1996-1998, 2001	1992
Kay Creek	15–17	1991, 1992, 1994, 1997-1999	1998
MF Clear Creek above Solo Creek	14–17	1994, 1995, 2011, 2015	1994
Solo Creek	14–17	2011, 2012	2011
Pine Knob Creek	16–17	2011, 2015	2015
Browns Spring Creek	16-17	2011, 2015	2012

Stream temperatures are likely to increase as a result of climate change which in turn may affect native fish distribution. Issak et al (2016). NorWeST temperature data shows historic temperatures in the mainstem of Clear Creek from 14-16 °C above Big Cedar Creek and 12-14°C in lower West, South, and Middle Forks. Climate change modeling to 2040 based on this data shows a 1-2 degree increase from in the mainstem from Big Cedar to just above the South Fork. The same increase is shown in the lower portions of its tributaries. By 2080, the model indicates another two degree rise in all streams. Modeled temperature at the Forest boundary is 17°C in 2080 and all tributaries above it range from 12 to 16°C.The higher the elevation of the stream, the cooler the temperature. While stream temperatures are expected to warm under climate change, modeled temperatures remain within optimum ranges for steelhead and salmon rearing on Forest managed lands in this project area out to 2080. The Clear Creek Watershed will become increasingly important as a refugia for listed steelhead in future decades.

Aquatic Species

A discussion of the fish species found in the project area, including ESA listed and Region 1 sensitive species, can be found in the 2015 FEIS, pgs. 3-8 through 3-10. Additional surveys were conducted by Stillwater Sciences in 2015 with the resulting information described below. The number of miles of fish bearing streams did not change as a result of the surveys. There are 65 miles of fish bearing and about 185 miles of non-fish bearing streams on Forest managed lands in Clear Creek. The surveys updated the amount of current fish use by prescription watershed.

Adult Chinook salmon were found in the mainstem of Clear Creek to just above its confluence with the Middle Fork of Clear Creek. Juveniles were found 1 mile below the confluence. Densities on Forest lands were highest near the boundary (28 fish /100m) and lowest near Middle Fork Clear Creek (11/100m). Both adults and juveniles were found in the lower 1.5 miles of South Fork Clear Creek in low densities (7 and 2 fish /100m, respectively). A few juveniles were observed in the very lowest reaches of West Fork Clear Creek. Overall, the highest densities (185 fish /100m) were found on private lands. This is likely a result of low stream gradient and large stream size, a requirement for this large bodied species. The area was also characterized by large amounts of suitable spawning substrate, low cobble embeddedness, and the presence of side channels which are important for juvenile.

Coho salmon juveniles were only observed below the Forest boundary in relatively high densities (range 53 to 250 fish/100m), indicating successful spawning in the mainstem.

Steelhead/rainbow trout were the most widely distributed species in Clear Creek and were found in most major tributaries. The highest densities were observed throughout the length of the mainstem of Clear Creek to just above Browns Creek (200 fish/100m). Lower densities were observed in Pine Knob, South Fork Clear, Middle Fork and Brown Springs Creeks (120, 110, 80, and 70 fish/100m, respectively). Densities in Hoodoo and the upper reaches of Clear Creek were lower (40 and 20 fish/100m, respectively) likely as a result of smaller stream size combined with steeper stream gradients.

Westslope cutthroat trout were found in the upper reaches of most tributaries and were patchily distributed in very low densities in the Clear Creek mainstem below Brown Springs. They were not found in the mainstem below Middle Fork Clear Creek. This observation is consistent with those in other streams on the Forest where cutthroat rarely overlap with salmon distribution and only have minor overlaps with steelhead. This is because cutthroat are smaller sized fish, require smaller sized spawning substrate and therefore can utilize smaller streams than the larger anadromous species. Densities of cutthroat were highest in Brown Springs and upper Clear Creek (100 and 60 fish/100m, respectively) and lowest in the West Fork (10 fish/100m). None were observed in the South Fork, Pine Knob or on private lands.

The Stillwater Report also noted extensive western pearlshell beds on private lands and on Forest lands on the mainstem downstream of South Fork Clear Creek.

Water Quality Objectives and the Forest Plan

The Forest Plan contains water quality objectives for streams in the project area (USDA Forest Service 1987a, Appendix A). These objectives are assessed using the DFC Analysis developed by Espinosa (1992) and are based on cobble embeddedness levels as directed by the Forest Plan Appendix A Guidance document (USDA 2011). Specifically, the guidance document states the following:

"Of the basinwide stream survey data collected over the years, the habitat components that appear to be the most repeatable and most reliably differentiate between reference and managed watersheds are measures or estimates of substrate condition, including cobble embeddedness and percent surface fines. In addition, fish/water quality objectives in Appendix A were originally established based on substrate sediment only (Stowell 1986).

…The portion of the DFC analysis that provides objectives for cobble embeddedness and percent fines by depth would be retained. Collection of measured substrate data, combined with existing legacy data and current PIBO data, where available, would be used to describe the existing condition. Substrate data would be the primary determinant in assessing whether Appendix A fish/water quality objectives are met."

Appendix A states that an upward trend (improvement) is required for streams that do not currently meet the water quality objectives. Timber management can occur in watersheds not currently meeting their water quality objectives concurrent with improvement efforts as long as a positive, upward trend in habitat carrying capacity is indicated. The Forest Plan provides no timeframe for when objectives must be met.

Cobble embeddedness (CE) is one measurement considered in the upward trend analysis. High cobble embeddedness can smother salmonid eggs and can reduce hiding space for young trout and salmon. Embeddedness can also reduce aquatic insect production which provides food for fish. The long-term trend in embedded cobbles is difficult to ascertain as they are based on weather events large enough to mobilize embedded stream materials, how cobbles interact with the sand that embeds them, and how the streambed interacts with streamflow and stream channel characteristics (Wohl et al, 2015).

In addition to challenges predicting when embedded streambeds mobilize and reorganize to more beneficial conditions, the measurement itself has some challenges. Peer reviewed literature since this methodology was created in the 1980's has identified some limitations. Sylte and Fishenich (2002) reviewed available embeddedness methods and found that not only were there slight differences in descriptions of how to complete data collection, but also that these differences could lead to differences in results. In some instances where embeddedness actually increases over time, one study reported lower values of embeddedness than were actually occurring because substrates accounted for in earlier measurements were completely buried and no longer accounted for. A comprehensive study by McHugh and Budy (2005) also highlights differences in results that correspond to probable methodology inconsistencies and the need for additional quantitative evaluation of methodology. Observer variability can also result in measurement differences (Roper et. al. 2002). Slight changes in location of the measurement could also provide different results, as could stochastic events. While the results can be variable, the embeddedness measures were instrumental in identifying the sediment being generated and deposited in streams by aggressive road building and harvest when they were first used in the 1980s.

Considering the requirement to use CE measures and the challenges with using them to predict improving stream conditions, Wolman pebble counts have also been collected to help describe surface bedload conditions. All subwatersheds, with the exception of Middle Fork Clear Creek, had lower percent of fines than the 22% "good" benchmark in Oregon for the Columbia Plateau, Northern Basin Range, and Snake River Plains (Stillwater, 2015). However, at some stream sites, embeddedness conditions are still considered unfavorable for salmon and trout and appear to be recovering slowly or not at all. At the same time, many roads in sediment generating locations have either been obliterated, stored, or reconstructed to reduce the sediment they can produce. Since the late 1990's, harvest units leave trees and undisturbed ground cover next to all identifiable streams, and roads are not built along stream-courses. These changes are expected to reduce management related sediment and protect riparian and aquatic habitat function over the long term.

The 2015 FEIS showed that Brown Springs, Solo, Hoodoo, Kay, and South Fork Clear Creek prescription watersheds met their objectives. More recent data collected by Stillwater Sciences shows that Pine Knob now meets its objective (Table 2). Hoodoo (West Fork) and South Fork now do not meet their objectives. The Hoodoo data is likely a result of different sampling locations in 2012 and 2015/2016. No new data was collected for Solo and Kay therefore they remain the same as shown in the 2015 FEIS (they meet Forest Plan objectives).

Table 2: Updated Water Quality Objectives for Prescription Watersheds in the Clear Creek Project Area.

Forest Plan Prescription Watershed	Forest Plan Water Quality Objective	Fishery Habitat Potential 1987	Percent Cobble Embeddedness (year)[a]	Fishery Habitat Potential[b]	Water Quality Objective Met?
Pine Knob Creek	80%	50%	30% (2015) 44% (2012)	82%	Yes
Browns Spring Creek	80%	50%	30% (2015) 30% (2012)	82%	Yes
Clear Creek	90%	50%	67% (2016) 38% (2012)	40%	No
Middle Fork Clear Creek	90%	50%	32% (2015) 51% (2014) 55% (1993)	81%	No
South Fork Clear Creek	80%	50%	47% (2014)	65%	No
Hoodoo (West Fork) Creek	70%	50%	71% (2016)	37%	No

A comparison of recent data shows that Pine Knob and Brown Springs are meeting and Middle Fork Clear Creek is close to meeting their objectives. Steelhead trout density data indicates Pine Knob has higher steelhead densities than Brown Springs or Middle Fork but all three streams have lower densities when compared to the mainstem of Clear Creek. The mainstem has the highest densities yet is far from meeting its objective based on embeddedness alone. The difference may be explained by the tributaries' smaller stream sizes and higher gradients which result in lesser amounts of suitable spawning and rearing habitat when compared with the mainstem. The South Fork and Hoodoo do not meet their objectives based on embeddedness. Steelhead densities in the South Fork are similar to Pine Knob (105 fish/100m) and are lowest in Hoodoo (40/100m), the lowest of all watersheds surveyed. This is likely due in part to small stream size, higher gradients and complete upstream migration barriers in the drainage. In general, cobble embeddedness may only be a partial limiting factor for steelhead trout in project area streams. Stream size, granitic geologies that typically have a higher component of fine particles and erosion rates, habitat availability and access also play a role.

Although the four prescription watersheds do not meet their Forest Plan water quality objectives, IDEQ (2014) has determined that they do meet their beneficial uses as discussed in the 2015 FEIS, pg.3-11. It is worth noting that even streams in roadless and wilderness areas often do not meet their DFCs (IDEQ 1999; various stream habitat surveys from the Clearwater NF) due to natural processes and the fact that streams systems are not static.

Management Activities Affecting Streams

PACFISH was designed to halt degradation and begin recovery of streams where listed fish species occur in the Columbia River drainage. It accomplishes this through streamside RHCA retention and other guidance for management activities within RHCAs. RHCA widths are 300 feet on each side of a fish-bearing stream, 150 feet on perennial non-fish-bearing streams, and 100 feet on intermittent stream channels. A minimum of 10,700 acres (24%) of the analysis area are within PACFISH buffers.

Timber Harvest

About 22% of Forest lands had regeneration harvest and all but 15 miles (8%) of non-fish bearing and/or intermittent streams adjacent to harvest units were buffered. All fish bearing streams were buffered. As a result of minimal harvest and buffering, fifty-seven percent of forested stands within RHCAs are older than 100 years, 34% are 40-100 years old and the remaining 9% are less than 40 years. (Figure 3-1, FEIS p. 3-13). Successional stage information combined with field reviews of the streams from 2010-2012 indicates that RHCAs are well vegetated and only minimally affected by timber harvest activities.

Stream temperature increases as a result of current timber harvest practices on federal lands are not expected. Several studies have shown that stream temperatures are protected by retaining buffers of <150' (Sweeney and Newbold, 2014; NCASI, 2000; Anderson and Poage, 2014; Ott et al 2005; Lee et al 2004; Sridhar 2004; FEMAT 1993). Buffers have been retained for over 50 years and 94% of streamside areas were not harvested, therefore management activities have not likely influenced stream temperatures. All fish bearing streams were buffered.

Several studies also found that buffers of this width are sufficient at minimizing or eliminating sediment delivery to streams from timber harvest (Hatten et al, 2018; Cristan et al, 2016; Sweeney and Newbold, 2014).

Roads

Roads near streams are the primary land management–related activity that may affect stream conditions in the project area as described in detail in the 2015 FEIS, pgs. 3-12 through 3-15. Roads within riparian zones confine channels which can affect sediment, wood and stream flow movement. Undersized culverts can plug with material and fail during high flow events leading to unwanted sediment pulses in streams. Riparian roads can reduce stream shading and disrupt large woody material recruitment through tree removal. Ditchlines that drain roads can direct flow and road surface sediment into perennial streams at crossings. These can be a chronic (ongoing) source of sediment and can increase water yield in streams. These conditions currently exist on many project area roads.

Management and road building in the Clear Creek watershed, especially from the late 1950's to the 1980's likely delivered substantial amounts of sediment that may still moving through lower gradient stream reaches to this day (Espinosa, 1997; Stillwater 2015). Shortly before the Espinosa article was published, the PACFISH decision of 1995 halted much of the aggressive harvest and road building on projects that could affect anadromous fish. While some harvest has continued since that time, RHCA's implemented under that decision stopped harvest next to streams unless it could be proven it was needed to improve riparian function. While it could be considered appropriate in some locations today (Reeves et al, 2016), harvest has not been conducted in project area RHCA's since PACFISH was implemented. Also since the Espinosa (1997) article was published, the US Forest Service passed a temporary road building moratorium (2000-2001), the Roadless Rule (2001), the Idaho Roadless Rule (2008), and the Access and Travel Management Rule (2005). Combined, these rule makings greatly restricted permanent road building and have led to management that has removed unneeded and potentially harmful road segments. A total of 10 miles of system and 73 miles of non-system roads have been decommissioned in the project area since 2012 and another 65 miles of non-system roads are NEPA cleared for decommissioning. Sediment reduction and maintenance have been the focus of treatments on the remaining roads needed for access. There have been 9 live water culvert replacements and 17.8 miles of road reconstruction including replacement of at least 38 cross drain culvert replacements since 2010. The project has identified additional road segments for treatment that are likely to cause sedimentation.

No new information regarding roads has been collected since the 2015 FEIS with the exception of a 2016 cross drain location survey on the project areas' two main log haul routes. It was conducted in order to assess the Road 650 and Road 286 cross drain culvert projects that were implemented 2014 and 2015. All cross drains were observed and an assessment was conducted to determine if additional cross drains were needed to improve drainage near streams. A total of 152 drains were inventoried on Road 650 and 187 drains on Road 286. A total of only 8 sites were located where additional cross drains are needed on these roads. These would be installed prior to project log haul activities.

Upward Trend Determination

Appendix A of the Forest Plan states that where streams do not meet their water quality objectives, timber management can occur concurrent with improvement efforts as long as a positive, upward trend in habitat carrying capacity is indicated. The 2015 FEIS, pgs. 3-16 through 3-23 describes the upward trend analysis process and provides the summarized upward trend discussions for the mainstem and Middle Fork Clear Creek prescription watersheds. A more complete upward trend for these streams is provided in Appendix J of the 2015 FEIS.

The following provides the summarized upward trend analyses for the South Fork Clear and Hooodoo prescription watersheds. The more complete analyses can be found in Appendix J of this DSEIS.

South Fork Clear Creek Prescription Watershed

The 12,940 acre South Fork Clear Creek Forest Plan prescription watershed does not meet its water quality objective of 80% for fishery habitat potential. Cobble embeddedness was measured at 47% in 2014. When assessed against the DFCs (USDA 1992), the watershed currently is at 65% of habitat potential. It was at 50% of its habitat potential when the Forest Plan was written in 1987. **This is considered an upward trend based on fishery habitat potential.**

There are about 12 miles of fish-bearing and a minimum of 20 miles of non-fish bearing streams in South Fork Clear Creek. Chinook adults and juveniles were found in the lower 1.5 miles (Stillwater Sciences, 2015) in low densities (1.6 and 7 fish /100m, respectively). Steelhead/rainbow were found in the lower 6 miles (220 fish/100m) and cutthroat were not observed; however, they have been documented in past surveys and are likely to occur in the upper half of the drainage.

Surveys in 2015 estimated the amount of anadromous and resident fish spawning habitat in the lower 5 miles of South Fork Clear Creek. Anadromous habitat was rated good to fair in quality but limited in quantity compared to the lower mainstem of Clear Creek (75m2/km vs. 580 m2/km). Resident spawning habitat was also rated as good to fair with roughly $25m^2$/km in the surveyed reaches. Spawning is limited both as a result of dominant substrates that are too large for spawning (>6" diameter) and high cobble embeddedness which may be due in part to batholith geologies. About a third of the watershed is underlain by these more erosive geologies. Although the amount of spawning habitat for both anadromous and resident fish is limited, fish densities indicate the availability of suitable spawning habitat. The larger dominant substrates provide for an abundance of rearing habitat as the surveyed reaches are higher gradient channels where there is less likelihood of sediment filling the interstitial spaces between the rocks.

Stream temperatures were measured at the mouth of South Fork Creek in 1991. Daily average temperatures were 13°C, or High (<14°C) for steelhead spawning and Low (>17.8°C) for summer steelhead rearing (18°C) based the NOAA Matrix table. Wildfires in 1870 and 1931 burned 7,085 acres and consumed most of the streamside vegetation which has created RHCAs currently dominated by trees that are about 80 years old. It is possible that they have not yet reached their full stream shading and cooling potential.

Stream temperatures were also measured where the South Fork meets Kay Creek for 9 years (1991-1998, 2001). Stream temperature conditions based on 2001 data showed NOAA Matrix ratings as Moderate (14-15.5°C) for steelhead spawning and High (<14°C) for rearing (14.3°C and 12.5°C respectively). They were Moderate (<15°C) for bull trout rearing (12.5°C) and Low (>10°C) for bull trout spawning/incubation (10.1°C). Stream temperatures in South Fork Creek appear to be adequate for chinook, steelhead and cutthroat production and low for bull trout.

Riffle and pool habitats made up 70% and 30% of stream habitats in 2015, respectively. Shallow water depths and lack of pool habitat were noted in the surveys. The low numbers are directly related to low wood levels (9 pieces/100m). Wood is the primary creator of pool habitats in this stream type. Low wood levels are naturally occurring as there has been no harvest adjacent to the surveyed streams. All lay within the Clear Creek Roadless Area. The low wood levels are due to the wildfires in 1870 and 1931 which consumed most of the riparian vegetation. Trees have reestablished themselves and are now about 80 years old. Timber harvest in the upper South Fork upstream from the surveyed reaches mostly retained streamside buffers. The presence of forested stands along all streams provides for both short and long term upward trends in water depths and pool habitat.

Stream bank stability was noted as good to excellent in both the1988 and 2015 surveys. This is due to the presence of dense streamside vegetation in combination with large substrate (cobble, rubble, boulders) which armors the banks against the erosive power of the stream. This trend has been maintained over time and would continue.

Stream substrate composition in South Fork Clear Creek in 2015 was dominated by boulders and rubble (68%), followed by gravel (18%), sand (12%) and bedrock (3%). Surveys in 1988 showed dominance by large rubble, boulders, and bedrock. Cobble embeddedness was 47% in 2016 and 51% in 1988 indicating a likely positive upward trend. Because the same sampling protocols were not used, the data is not directly comparable; however given the low road densities and no evidence of recent landslides, the assumption of an upward trend is reasonable. A review of roads between 2010 and 2012 found no major sediment issues associated with roads that might affect fine sediment levels in the drainage.

Regeneration timber harvest activities have occurred on 13% of the watershed between the 1930's and 1990's. No regeneration harvest has occurred since then. ECA is currently at 1% as a result of minimal harvest. Streamside buffers of 100'+ were retained on all but 3.3 miles of non-fish bearing or intermittent streams. Forested stands within RHCAs are aged as follows: 5% are < 40 years old, 54% are between 40 and 100 years and the remaining 41% older than 100 years. The RHCAs are considered fully functional given the age classes and minimal disturbance within them. As a result, they are trending in an upward condition and would continue to provide for shade, wood, and bank stability in the South Fork of Clear Creek.

There are almost 32 miles of Forest system roads within the watershed with less than 4 miles occurring within RHCAs. The overall watershed road density is 1.6 mi/mi2 and the RHCA road density is 1 mi/mi2. A total of 1.5 miles of the RHCA roads are opened to motorized traffic and the remaining are closed. About 20 miles are gravel surfaced and many of the remainder were topped with grasses/mosses and had small trees growing along their margins. There were no obvious signs of road surface erosion (no rilling or gullying) during culvert inventories from 2010 to 2012. A total of 2 miles of system road and 26 miles of non-system road have been decommissioned since 2012. This is a 6% reduction in system road densities. Road treatments included abandonment near ridgetops to full recontouring on midslope roads or roads with stream crossings. Roads with stream crossings were recountoured and roads without them were either recontoured or abandoned depending on their location. Decommissioning results in short term sediment increases at stream crossing removal sites but removes the risk of future crossing failure. Decommissioning is expected to contribute to the long term reduction of sediment delivery to streams.

There are 45 stream crossings within the watershed with none occurring on fish bearing streams. Nineteen of the crossings were identified as needing cross drain additions and 13 need to be replaced as they are undersized. Ditchlines in the drainage were well vegetated which help to filter out sediment to streams. There are no human caused barriers to upstream aquatic organism migration in the watershed.

In summary, Forest Plan Appendix A Guidance (USDA, 2011) states that "…*In previously degraded watersheds, especially those identified as below objective in 1987, if there have been no entries or natural disturbances over the past 10 to 20 years, it could be assumed that trend is either static or improving.*" It also states that "*It was assumed in the Forest Plan that implementation of instream restoration and other watershed restoration activities would result in an upward trend in carrying capacity. Where these activities have been implemented, it could be stated that an upward trend in the habitat conditions has been accomplished*". **It has been 22 years since any timber harvest has occurred in the drainage. When combined with well vegetated riparian areas, relatively few stream crossings, past road decommissioning projects, mostly closed roads and no obvious sources of sediment, an upward trend in fish habitat capacity is indicated in the South Fork Clear Creek.**

Hoodoo/West Fork Clear Creek Prescription Watershed

The 6,450 acre Hoodoo Creek Forest Plan prescription watershed, which includes West Fork Clear Creek, does not meet its water quality objective of 70% for fishery habitat potential. Cobble embeddedness was measured at 71% in 2016. When assessed against the DFCs (USDA, 1992), the watershed currently is at 37% of habitat potential. Sediment is likely one of the contributing limiting factors for fish production in this prescription watershed. However, as discussed in the Appendix A Guidance and 2015 FEIS, upward trend is not determined by cobble embeddedness alone (USDA, 2011).

There are about 5 miles of fish-bearing and 20 miles of non-fish bearing streams in the drainage. Fish densities are low due to steeper gradients and larger than preferred spawning substrate. No Chinook salmon were observed in 2015; however 4 juveniles /100m were observed in 2016. Steelhead/rainbow were the most common species found and numbers observed were low at 40 fish/100m, respectively. Westslope cutthroat trout were observed in low densities in 2015 (17 fish/100m).

Surveys in 2015 estimated the amount of anadromous and resident fish spawning habitat in West Fork Clear Creek. Anadromous habitat was rated as fair in quality and low in quantity ($25m^2$/km). Resident spawning habitat was rated as good to fair with only $13m^2$/km in the surveyed reaches. The amount of spawning habitat for both anadromous and resident fish is likely to remain limited. This is due to steeper stream gradients which limits spawning habitat availability, the dominant substrate size which is too large for spawning, and high cobble embeddedness in the few low gradient reaches. High sediment and embeddedness levels may be due in part to the underlying batholith geology which underlies 69% of the watershed.

Stream temperatures were measured in West Fork Clear Creek in various years (1991, 1992, 2011, 2012, 2015, and 2016). Stream temperature conditions based on NOAA matrix ratings were moderate for steelhead spawning and rearing (15°C and 17°C, respectively). Temperatures were low for bull trout spawning and moderate for bull trout rearing (14°C and 15°C, respectively). Summer water temperatures are considered to be warmer than preferred for bull trout.

Stream bank stability was noted as good to excellent in both the 2015 and 1988 surveys as well as during field reviews between 2010 and 2012. This is due to the presence of dense streamside vegetation in combination with large substrate (cobble, rubble, boulders) which armors the banks against the erosive power of the stream.

Stream substrate composition in West Fork Clear Creek in 2015 was composed of 22% fine material (sand/silt <6mm), 26% gravel and 52% large material (rubble to boulders). Cobble embeddedness, which cannot be directly correlated to the percent of fine substrates, was 71% in 2016 and 33% in 2012 (FEIS, pg. 3-11). The data between the two years, however, is not comparable as 2016 sampling occurred near the mouth of the stream and 2012 sampling occurred 1.8 miles upstream near the confluence of Hoodoo and West Fork Clear Creeks.

Instream sediment in the Hoodoo prescription watershed is likely associated with roads. Two road related slides on Road 650 were observed between 2011 and 2017. Repairs were conducted on the slide closest to the Forest boundary in 2012 and repairs are planned for the upper slide in 2018. Both slides delivered unknown quantities of sediment to the stream. While it would be desirable to remove these segments of road from an aquatics perspective, travel management considerations identified the road as essential for providing for management and public access. Overall, sediment levels are very high in the watershed based on limited sampling. However as noted by Sylte and Fischenich (2002), cobble embeddedness exhibits high spatial and temporal variability in both natural and disturbed streams. Sampling must be intensive within streams or stream reaches to detect changes. Intensive sampling has not occurred and surveys were not conducted in the same location between years. Determining a trend for embeddedness is therefore not possible given the lack of available data. Additionally, extensive road decommissioning, has been implemented since 2012 and may also be contributing, in part, to higher levels in the short term.

Riffle and pool habitats made up 65% and 35% of stream habitats in 2015, respectively. While the overall percent of pools was somewhat low, the frequency of those pools were the highest noted in the surveyed watersheds. This is due to relatively high frequencies of large wood present in the stream and the well forested stands along its length.

Regeneration timber harvest activities have occurred on 34% of the watershed between the 1950s and 1996. No harvest has occurred since then. Streamside buffers of 50'or larger were retained on all but 4 miles (13%) of non-fish bearing or intermittent streams beginning in the 1970s. Harvest retained buffers of 100-400' on all fish bearing streams. ECA is currently at 4%, or a high condition. Forested stands within RHCAs are aged as follows: 10% are < 40 years old, 50% are between 40 and 100 years and the remaining 40% older than 100 years. The middle age classes are partly a result of a wildfire which occurred in 1931. The fire burned 27% of the drainage and 43% of the RHCAs. The RHCAs would therefore be considered mostly functional given the large percentage of older age classes and minimal human related disturbance within them. As a result, they are trending in an upward condition and would continue to provide for shade, wood, and stable banks in the West Fork Clear Creek drainage.

There are 32 miles of Forest system roads within the watershed with 5 miles occurring within RHCAs. A total of 2 miles of the RHCA roads are opened to motorized traffic and the remaining roads are closed. The overall watershed road density is 3.8 mi/mi2. The RHCA and landslide prone road densities are 2.3 mi/mi2 and 0.2 mi/mi2, respectively. A total of 10 miles of system road and 36 miles of non-system road have been decommissioned since 2012. There has been a 20% reduction in system roads since 1995 as a result of the decommissioning. The 36 miles of non-system roads do not contribute to road density calculations but their removal has contributed to the reduction of the potential sediment effects to streams. Improving trends in instream sediment are expected over time as a result.

There are 41 stream crossings within the watershed, one of which occurs on fish bearing streams. It was replaced in 2012 and is no longer a barrier to upstream passage. A total of 30 culverts are appropriately sized and the remaining 11 crossings are undersized for the area they drain. All roads cross perpendicular to the stream channels limiting their effects to riparian vegetation; however portions of the ditchlines drain directly into the streams. These 6 sites may be acting as a chronic sediment source of sediment to streams. Ditchlines leading to the 1 fish bearing crossings currently have cross drain pipes installed and are no longer adding sediment to streams at those sites.

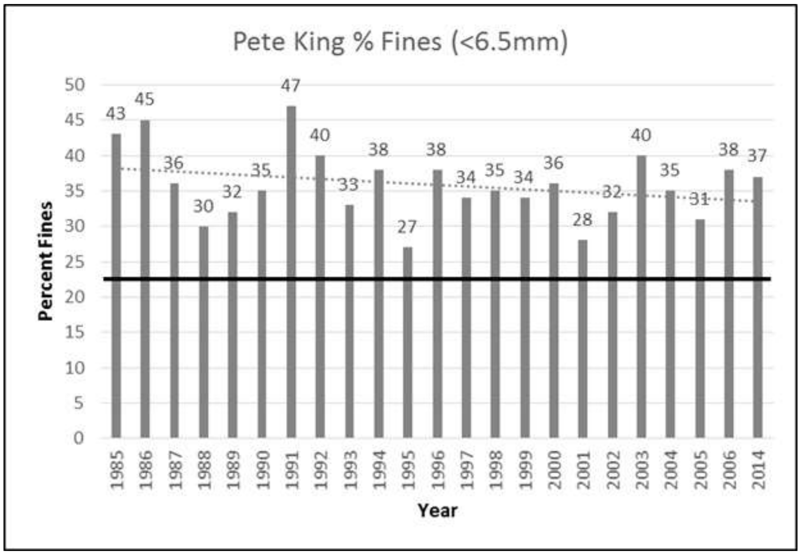
In summary, **it has been 22 years since timber harvest occurred in the Hoodoo (West Fork) Clear Creek prescription watershed. RHCAs are intact and in a state to provide for long term streambank stability, shade and large wood. As a result, they will contribute to long term aquatic habitat maintenance and improvement. Recent road decommissioning, live water culvert replacements, and cross drain culvert replacements have been implemented in order to reduce road related sediment delivery to streams. Also, the majority of roads are closed to motorized use which limits degradation of the road surface and potential sediment delivery to streams. When compared to past watershed conditions, these activities are expected to have initiated an upward trend in fish habitat capacity in this prescription watershed.**

General Long-term Trends in Sediment

Long term steelhead spawning gravel monitoring data elsewhere on the Forest suggests overall downward trends in instream sediment. Monitoring was conducted in Pete King and Deadman Creeks, tributaries to the nearby Lochsa River, and was designed to assess the effects of road decommissioning on instream sediment levels. Sediment coring data techniques were used to assess the percent of fine sediment in spawning gravels. Pete King Creek was the study's treatment area where 55 miles of road decommissioning occurred and Deadman was the control drainage. No decommissioning and relatively few roads occur in Deadman. Past timber harvest occurred in both drainages. Figures 1 and 2 display variable levels of fine sediment with overall decreasing trends in both the treated and untreated systems.

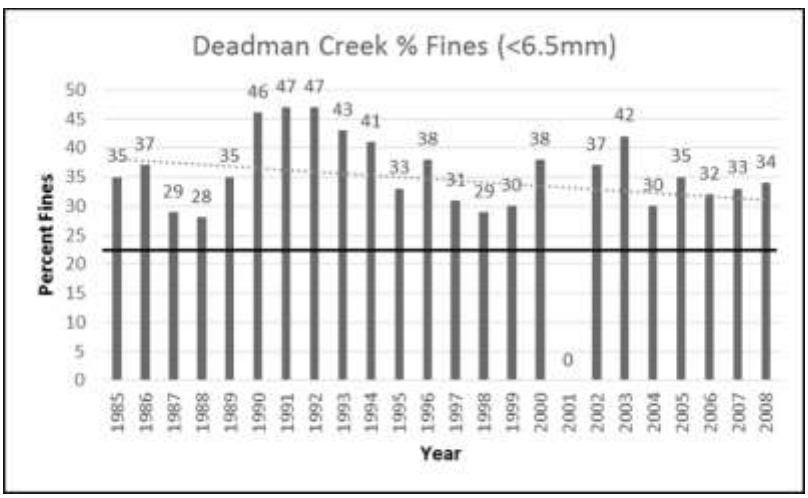
The observed sediment decreases are hypothesized to be a result of improved timber harvest practices which include the application of Best Management Practices and PACFISH, the reduction in overall timber harvest and new road construction, and road decommissioning (Jones, 2001). In summary, we believe these practices are at least partially responsible for the observed declining trends in fine sediment.

Figure 1: Comparison of Average Percent Fines (<6.5mm) for Years 1985 to 2006 and 2014 at Permanent Substrate (coring) Monitoring Sites in Pete King Creek within the Lochsa River Drainage. No Data was collected between 2007 and 2013.



Black line denotes Forest Plan desired conditions (22 – 24%) – the long term average was 35%

Figure2: Comparison of Average Percent Fines (<6.5mm) for Years 1985 to 2008 at Permanent Substrate (coring) Monitoring Sites in Deadman Creek within the Lochsa River Drainage. No data was collected in 2001.



Black line denotes Forest Plan desired conditions (22 – 24%) – the long term average was 35%

Effects of the Alternatives

The analysis area for the direct and indirect effects of the alternatives is the project area as discussed in the 2015 FEIS, pg. 3-1.

Alternative A- No Action

No logging or road-related activities designed to reduce sediment to streams would occur under this alternative. Any watershed improvement activities would require additional NEPA analysis prior to implementation. The effects of the No Action are discussed in the 2015 FEIS, pgs. 3-25 and 3-26.

In addition, this alternative would increase the risk of wildfire within the Clear Creek drainage which could result in sediment inputs to streams as well as riparian vegetation loss. These effects were observed after recent wildfires in the adjacent Lower Selway River drainage. The 11,300 acre Johnson Bar Fire occurred in 2014, the 10,200 acre Slide and 34,300 acre Wash Fires occurred in 2015. The fires were a result of continued surface fuel buildups due to increased insect and disease activity, weather conditions conducive to fire starts, and past fire suppression. The 4,800 acre Baldy Fire, also in 2015, partially burned into the upper South Fork of Clear Creek leaving 500 acres in headwater areas with 100% tree mortality.

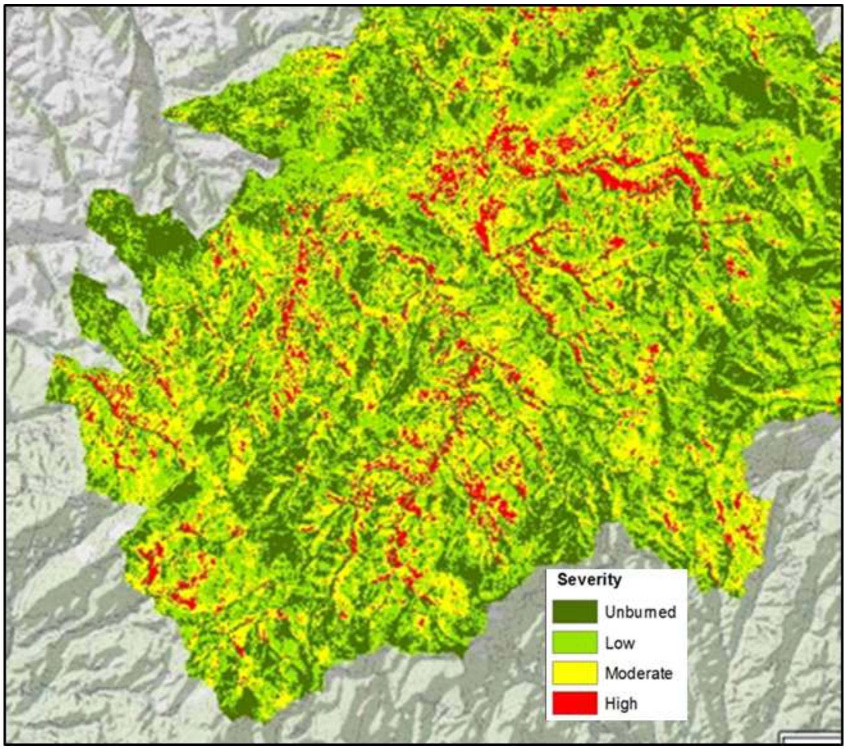
Within the Johnson Bar Fire area, a total of five large fire-related landslides occurred, three in Swiftwater Creek in 2017 and two in Goddard Creek in 2018. An estimated 230 tons of material was delivered to Swiftwater Creek. Field reviews showed stream channel downcutting, a reduction in instream wood levels below the slides, loss of pool habitats and an increase in substrate size which reduced the availability of suitable spawning (USDA, 2017). Positive effects included a 5-10% reduction in cobble embeddedness in Swiftwater Creek as a result of fine sediments being flushed out of the system. Gravel suitably sized for spawning was added to the system via the slides. Large amounts of wood were also delivered to the stream; however most currently does not contribute to fish habitat since it deposited on high floodplain areas away from the stream channel. It will likely take decades and many high flow events to move this wood into areas where it can interact with the stream and directly contribute to aquatic habitat. Riparian area tree mortality caused by the fires exceeded 70% in many tributaries to Swiftwater, Goddard and Meadow Creeks. This may lead to stream temperature increases; however, a retrospective fire study in the Boise River basin (Dunham et al 2007) showed that while stream temperatures may remain elevated for at least a decade following wildfire, native aquatic invertebrates (rainbow trout and tailed frogs) were resilient to those increases. Summer temperatures ranged between 11 and 26^{o}C in the study. The upper end of the range is well above measured temperatures in Clear Creek.

Clear Creek forests have evolved with fire; however land management has replaced fire as the primary disturbance on the landscape since the 1930s and fire has been excluded in order to protect the timber resource. Dense tree planting after harvest has led to stands with full touching canopies and low hanging branches (i.e. ladder fuels) that provide avenues for crown fires. Older, unharvested stands are succumbing to increased insect and disease activity leading to abundant down wood and subsequent increased surface fuels. The combination of ladder and surface fuels is similar to those found in the Lower Selway area prior to 2014 and 2015. With the right weather conditions, fires will occur in Clear Creek.

Under this alternative, no harvest would occur. This would lead to continued increases ladder and surface fuels across the watershed as trees continue to grow, die and fall. The risk of harder to control fires increases with increasing fuels. The resulting effects to streams cannot be estimated, but they would include potential surface erosion from burned slopes as well as landslides. Elliot and Miller (2017) modeled the project area using GeoWEPP. The model showed potential high severity fires along much of the South and Middle Forks of Clear Creek as well as Pine Knob and Brown Springs Creek (Figure 3). Increased erosion was also predicted to be much greater than under the no action alternative. Surface erosion delivered to streams would likely settle out in the lower gradient fish bearing streams potentially reducing the quality and quantity of spawning and rearing habitat. Landslides could result in channel downcutting and both the addition and loss of wood and their associated pools. This could result in both losses and improvements in fish rearing habitat. Gravel deposits from landslides are likely to increase spawning habitat in some areas. Riparian contributions to instream wood levels would increase where riparian areas are burned; however short term stream temperatures may also increase in these areas (Mahlum et al, 2011). Recent observations of fires on the Forest show the areas that are most likely to experience stand replacing fires are near ridgetops and in the headwaters of streams. These headwaters contribute to stream cooling. Their effect on mainstem streams could be reduced in the event of large fires. It is very likely that the 1931 fire resulted in increased stream temperatures in the South Fork Clear

Creek due to canopy loss over the mainstem stream. The risk of fires burning along mainstem streams increases with more uncontrollable fire behavior.

Figure 3: Modeled Burn Severity under Current Conditions in Clear Creek (Elliot and Miller, 2017)



In summary, this alternative would inhibit the ability of the Forest to further limit or reduce sediment delivery to streams from roads in order to meet or maintain Forest Plan water quality objectives. Roadside ditches would continue to deliver sediment to streams indefinitely due to inadequate cross drains. The risk of crossing failures would increase as culverts age and their conditions deteriorate. This alternative would also maintain a greater risk of high severity fire with the resulting positive and negative effects to aquatic habitats and riparian areas. The magnitude of those effects, however, cannot be estimated.

Alternatives B, C, C Modified, and D

The direct, indirect and cumulative effects of action Alternatives B, C, and D are discussed in the 2015 FEIS, pgs. 3-26 through 3-35. The discussion below updates the FISHSED model outputs which were incorrectly calculated and displayed in the 2015 FEIS and analyzes Alternative C Modified. It also includes a brief discussion of why the modeled analyses are considered overestimates through a comparison of the acres analyzed in NEPA versus the acres of harvest after actual on the ground layout occurs as a result of design feature implementation.

Outputs from the NEZSED model were used to identify road segments likely to be producing the most sediment. Field reviews occurred and found that the highest producers would have work conducted on them that is designed to minimize sediment.

FISHSED Updates

The Forest Plan requires the use of the FISHSED model in order to compare modeled changes in cobble embeddedness between action alternatives. It is not design to predict actual changes in embeddedness. It also predicts potential changes in summer and winter rearing habitat capacity as a result of changes in embeddedness. It is most appropriately used to assess the effects of changes in habitat quality when cobble embeddedness changes are greater than 10-20% (Stowell, et al 1983). Additional information on the model can be found in the FEIS, pg. 3-3. Table 3 displays the FISHSED outputs by Forest Plan prescription watershed. Brown Springs and Solo exceed a 10% change for cobble embeddedness under all alternatives. Brown Springs, Solo and Hoodoo exceed a 10% change for winter rearing under all alternatives. The changes remain below the 20% identified by Stowell (1983) but above the 10% suggested by the Forest Plan Appendix A Guidance document (Conroy and Thompson, 2011).

Table 3: FISHSED Model Outputs by Prescription Watershed

Prescription Watershed	Percent Change from Existing Condition		
	Alt B	Alt C	Alt D
Pine Knob			
Cobble Embeddedness	6	6	6
Summer Rearing	2	2	2
Winter Rearing	9	9	9
Brown Springs			
Cobble Embeddedness	***15***	***15***	***14***
Summer Rearing	2	2	2
Winter Rearing	***14***	***14***	***13***
Clear Creek			
Cobble Embeddedness	4	4	4
Summer Rearing	3	4	3
Winter Rearing	8	9	8
Solo			
Cobble Embeddedness	***12***	***13***	***12***
Summer Rearing	1	2	1
Winter Rearing	***12***	***13***	***12***
Middle Fork Clear			
Cobble Embeddedness	4	5	4
Summer Rearing	2	2	2
Winter Rearing	7	8	7
Kay			
Cobble Embeddedness	2	2	2
Summer Rearing	1	1	1
Winter Rearing	4	4	3
South Fork Clear			
Cobble Embeddedness	3	3	2
Summer Rearing	1	1	1
Winter Rearing	4	4	4
Hoodoo			
Cobble Embeddedness	6	7	5
Summer Rearing	6	7	6
Winter Rearing	***13***	***14***	***12***

While modeling indicates potential increases over 10% for some watersheds, local field observations indicate otherwise. Monitoring along 23 miles of RHCAs found no sediment delivery through the buffers

(USDA, 2014). In addition, visual observations of post-harvest areas found the same results (K. Smith, personal observations, 2000-2013). This is due to thick ground cover vegetation which filters out sediment that may be moving down slope from harvested areas. The NEZSED model is based on the number of acres of proposed timber harvest, road construction, reconstruction and decommissioning as well as prescribed burning. It also assumes that all activities will occur within one year as opposed to the expected 7 year or more timeframe of project activities. In addition to model assumptions, and as described below, the actual acres of proposed activities are expected to be 20-30% less than the acres analyzed in NEZSED; therefore the FISHSED modeled changes would be less as well. Based on local monitoring results, restricted model assumptions and expected overestimates by the model based on actual harvest acres, no substantial change in cobble embeddedness or winter rearing from proposed activities is expected for Brown Springs, Solo, or Hoodoo prescriptions watersheds where modeled increases are over 10%.

Potential Effects – NEPA vs. Actual Layout Acres

A comparison between the acres analyzed in the 2015 FEIS and actual unit layout was conducted in 2015. The harvest units are within the Hoodoo Prescription watershed and constitute the proposed Lost Mule sale. The actual unit acreage as a result of field layout was 34% less than the NEPA acres analyzed. The reduction is primarily due to the buffering of unmapped streams and the verification and buffering of landslide prone areas. Similar comparisons have been made for other timber harvest units with all resulting in a 20-35% reduction in harvest acres. The FISHSED model results and actual expected effects previously discussed are therefore considered overestimates. The actual effects would be limited in amount and scope based on fewer acres being harvested. RHCA monitoring has confirmed the limited effects as previously discussed (USDA, 2014).

Alternative C Modified

The direct and indirect effects of this alternative are the same as those described for Alternatives B, C, and D shown in the FEIS pgs. 3-25 through 3-31 with the exception of the FISHSED model outputs described above. There would be short term increases in sediment as a result of culvert replacements and road decommissioning. The effects to ESA listed steelhead trout are associated with the culvert replacements and would be minimized through design criteria. Minimal to no effects from harvest are expected due to design feature implementation including RHCA retention and on or near ridgetop locations of temporary roads. There are 579 acres less of regeneration, 283 less acres of commercial thinning, and 43 acres less of improvement harvest than Alternative C under this alterative. Units or portions of units were removed from Clear Creek, Pine Knob, Brown Springs, Kay, South Fork and Hoodoo prescription watersheds. Removal of these acres reduces the risk of potential erosion or landslides on the steeper terrain in which they occur. They were not modeled as landslide prone; however they do occur on relatively steep slopes. Others were removed as they are likely to occur within RHCAs.

All action alternatives would reduce ladder and surface fuels across the Clear Creek drainage through regeneration, intermediate, and improvement harvest as well as prescribed landscape burning. These activities would help to moderate fire behavior which would also reduce the potential for high severity fire (Elliot and Miller, 2017). The risk for increased stream temperatures as a result of high severity fire would be reduced compared to the No Action alternative. The risk of increased surface erosion and sediment delivery to streams would also be reduced.

Cumulative Effects

A discussion of the cumulative effects including the analysis area can be found in the 2015 FEIS, pgs. 3-32 through 3-35. The only change in the cumulative effects analysis is the timeframe considered for cumulative effects which is currently 2019 to 2026. There is no change in the cumulative effects analysis for stream crossings from the 2015 FEIS. Other components of the analysis are discussed or reiterated below.

Alternative A

Activities on private and state lands where harvest or fuel reduction treatments has occurred would reduce the risk for high intensity, less controllable fire on those lands. More intense fire behavior risk would be maintained on National Forest lands due to increased surface and ladder fuel loading. This could to lead to increased risk for landslides and riparian area mortality with the resulting negative and positive effects discussed under the indirect effects of the No Action alternative. There could be a reduction in the quality and quantity of steelhead/chinook habitat downstream on private lands (including the Kooskia fish hatchery) from increased sediment as well as potential increases in stream temperatures. Summer stream temperatures below the Forest boundary are nearing sublethal to lethal levels and are projected to increase as a result of climate change (Isaak, et al, 2016). Minor changes on Forest managed lands could result in slightly higher levels downstream. Instream wood levels would increase as a result of landslides and would be beneficial to aquatic habitats. The potential changes in sediment, temperature, and wood are completely dependent on the size and location of wildfires that might occur. The extent of the potential positive and negative effects cannot be assessed; however based on 2014 and 2015 fires in the adjacent Selway River area, they could have large, localized effects.

Alternatives B, C, C Modified, and D

No negative cumulative effects to instream sediment are expected because FISHSED-modeled changes are within the Stowell model (1983) guidelines and 5% or less over Forest Plan Appendix A guidelines. Actual harvest acres are expected to be 20-30% less than those analyzed, therefore the described effects would be less than modeled. Modeled sediment yield at the Forest boundary would be 23%, 24%, and 21% for Alternatives B, C, and D, respectively. All alternatives remain below the Forest Plan objective of 30%. Alternative C Modified was not calculated however it would be less than Alternative C because there are 924 acres less of harvest than Alternative C. Sediment yield would drop to below existing levels within 6 years (Watershed Report). There would be no long term sediment yield increase as a result. When combining local monitoring with modeling outputs, no cumulative sediment increases to downstream areas of Clear Creek, including the Kooskia Hatchery, are expected. Culvert replacement, road reconstruction, road reconditioning, and decommissioning activities result in minor short term increases in sediment. They would provide for long term (>50 years) instream sediment reduction by reducing the risk of road failures where crossings are replaced or removed and cross drain culverts are installed. Undersized culverts on private lands would still pose a failure risk and could contribute sediment to Clear Creek.

The action alternatives, when combined with harvest or fuel reduction treatments on non-federal lands, would cumulatively reduce the risk for fire and the subsequent effects to aquatic habitats. The amount cannot be estimated; however studies have shown that modification of fuels helps reduce the potential for high intensity fire. Moderated fire behavior is likely to result in less hillslope erosion and riparian tree mortality while allowing for localized sediment and wood delivery from less intense fires. This would help to better maintain streamside shade and provide for long term large wood and streambank stability.

Regulatory Compliance

Endangered Species Act

The effects determinations for fish species listed under the Endangered Species Act are the same as described in the 2015 FEIS, pgs. 3-35 through 3-29.

In summary, the project would have both short term negative and long term beneficial effects to steelhead and their designated critical habitat as well as Essential Fish Habitat (EFH) for salmon from road removal, culvert replacement, and road reconstruction/reconditioning activities. The risk for potential effects to steelhead trout, designated critical habitat or EFH from road-related project activities could occur, therefore the ESA effects determination for the project is **may affect, likely to adversely affect steelhead trout, their designated critical habitat, and EFH**. An adverse effect constitutes harm or harassing listed fish. Adverse effects to steelhead, their designated critical habitat, or EFH are expected to be minimal due to BMP implementation.

The Clear Creek IR Project is consistent with the 1998 Biological Opinion for Salmon and Steelhead in the Upper Columbia and Snake River Basins in that it applies PACFISH direction and does not prevent the attainment of PACFISH RMOs, conducted a watershed analysis that identified needs to improve habitat for listed steelhead in Clear Creek, and conducted project level Section 7 consultation.

The project **may affect, but is not likely to adversely affect bull trout** since they were only sporadically found in the lower drainage below the Forest boundary. Temperature regimes are not within desired ranges for bull trout during the spawning migration period. Temperatures at the mouth of the streams create a thermal deterrent during this time. The proposed activities are not expected to directly or indirectly affect the species because the project would allow for the maintenance of natural temperature ranges through PACFISH buffer retention. Timber harvest would increase modeled sediment yield and cobble embeddedness levels but not to measurable levels. There would be **no effect to bull trout designated critical habitat** since none exists in the drainage.

Region 1 Sensitive Species

The effects determinations for fish species listed under the Endangered Species Act are the same as described in the 2015 FEIS, pg. 3-39.

PACFISH

The project complies with PACFISH and would not retard the attainment of Riparian Management Objectives as described in the 2015 FEIS, pgs. 3-39 through 3-40.

Forest Plan

All action alternatives comply with the Forest Plan Water Quality Objectives and the upward trend requirement. FISHSED modeling indicates changes over 10% in cobble embeddedness and winter rearing in three prescription watersheds; however these watersheds remain within acceptable model ranges (Stowell, 1983) and are 5% or less above Appendix A guidance. Actual changes are not expected because harvest acres would be less than modeled, and because of sediment reductions associated with road decommissioning and reconditioning/reconstruction activities. Watersheds are expected to continue on an improving trends as a result of these activities when combined with RHCA retention and other design features. Pine Knob, Clear Creek, and Middle Fork Clear Creek prescription watersheds are discussed in the 2015 FEIS (Pgs. 3-40 to 3-42).The following discusses the effects of the actions on upward trend in the Hoodoo and South Fork Clear Creek prescription watersheds which do not currently meet their water quality objectives based on findings of the 2015 Stillwater survey.

Upward Trend

All alternatives propose the same actions related to roads including reconditioning, reconstruction and decommissioning as well as culvert replacements. All alternatives would maintain an upward trend. Alternative C was the only alternative assessed as it proposes the most harvest and temporary road building.

Hoodoo (West Fork) Prescription Watershed

The Clear Creek Project would continue the existing upward trend by decommissioning an additional 0.8 miles of road, 0.2 miles of which is within RHCAs. This would not change watershed or RHCA road densities from the existing conditions of 3.8 mi/mi^2 and 2.3mi/mi^2, respectively. The majority of road decommissioning and road improvement were conducted under previous project between 2012 and 2015 (2015 FEIS, Appendix J, pg. J-40).

The Clear Creek Project also reconstructs 15.3 miles of system road (40% of the roads in the prescription watershed) which would reduce sediment delivery by diverting road ditchline flow through cross drain culverts and away from streams. A total of 9.9 miles was already completed under the Road 650 Project in 2014.

The Clear Creek project would replace the 11 existing undersized culverts with those sized for a 100- year flow event. This would reduce the risk of future failure. All crossings in the watershed would be appropriately sized after project completion. The Project would recondition 7.1 miles of road (19% of the roads). Reconditioning would apply gravel where needed to minimize the amount of erosion from road surfaces during log haul operations. The use of dust abatement during log haul would also minimize road surface erosion and potential input of sediment to streams.

All project activities are expected to have a negative effect on aquatic condition in the short term based on sediment yields as modeled in NEZSED. Model results from NEZSED indicate sediment yield increases at the mouth of West Fork Clear Creek to 55% as a result of project activities. This meets the Forest Plan standard of 60%. The FISHSED model was used in conjunction with NEZSED to determine potential changes in fish habitat carrying capacity. The model predicted a 7% increase in cobble embeddedness and decreases in summer/winter juvenile steelhead rearing capacity of 7% and 14%, respectively. Winter rearing capacity exceeds the level of 10% where changes in habitat quality could occur (Stowell et al. 1983); however, local RHCA monitoring found no sediment delivery through the buffers (USDA, 2014). Visual observations of post-harvest areas found the same results elsewhere on the Forest (K. Smith, personal observations, 2000-2013). With no delivery, cobble embeddedness levels are not expected to increase as a result of harvest. FISHSED model documentation states that the effects evaluation should be adjusted if riparian areas are to be treated differently than surrounding land. PACFISH RHCAs retain no harvest buffers that are much wider than those used when FISHSED was developed; therefore the model results are considered overestimates, particularly when combined with fewer actual acres of harvest (NEPA vs. layout acres).

Modeled ECAs would increase to 26% under Alternative C, a Moderate condition class rating based on the NOAA matrix (1998). This exceeds the desired threshold of 20%. However, no channel alterations as a result of increased water yield are expected. This is due to the loss of 20-30% of the harvest acres during unit layout, compared to those modeled, as previously discussed. Alternative C Modified would harvest 418 less acres than Alternative C, therefore ECA would be slightly lower than modeled estimates.

An upward trend has been established through mostly intact RCHAs, a lack of recent timber harvest, previous road decommissioning, culvert replacement, and road improvement projects. The Clear Creek Integrated Restoration Project would maintain that trend through additional road improvement when combined with design features, and BMP implementation. Many studies have confirmed the success of the BMPs in reducing sediment delivery to streams and maintaining stream temperatures (Sugden, 2018; Arismendi et al, 2107; Hatten et al 2017; Sugden et al 2012; USDA Forest Service 2009; USDA Forest Service, 2006; Sridhar et al, 2004; Lee, et al 2004; Ott et al 2005).

South Fork Clear Creek Prescription Watershed

The Clear Creek Project would continue the existing upward trend through road improvement activities including the replacement of 27 stream crossing culverts, 16.5 miles of road reconstruction (51% of the roads in the prescription watershed) and 9.8 miles of reconditioning (30% of the roads in the prescription watershed). All of these are designed to reduce the amount of sediment delivery to streams from roads. Road decommissioning and reconstruction activities were conducted under previous projects between 2012 and 2014 (2015 FEIS, Appendix J, pg. J-37).

All project activities are expected to have a negative effect on aquatic condition in the short term based on sediment yields as modeled in NEZSED. Model results from NEZSED indicate sediment yield increases at the mouth of South Fork Clear Creek to 14% as a result of project activities. This meets the Forest Plan standard of 45%. The FISHSED model was used in conjunction with NEZSED to determine potential changes in fish habitat carrying capacity. The model predicted a 3% increase in cobble embeddedness, a 1% decrease in summer rearing and a 4% decrease in winter rearing capacity. These are well below the threshold of 10% where changes in habitat could occur (Stowell et al. 1983).

ECAs would increase to 9% under Alternative C, a High (good) condition class rating based on the NOAA matrix (1998). This meets the desired threshold of <20%. No stream channel alterations are expected as a result of minor increases in water yield. Alternative C Modified would harvest 289 less acres than Alternative C, therefore ECA is expected to be slightly lower than modeled estimates.

An upward trend in aquatic habitat conditions in South Fork Clear Creek has been established through previous road decommissioning and road improvement projects. The Clear Creek Project would maintain that trend through additional road improvement activities when combined with relatively intact RHCAs, and design feature and BMP implementation.

/s/ *Karen A. Smith*
Project Fisheries Biologist

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